


Johnson Space Center Engineering Directorate

L-8: Docking Systems and other Attachment/Release mechanisms and related technologies

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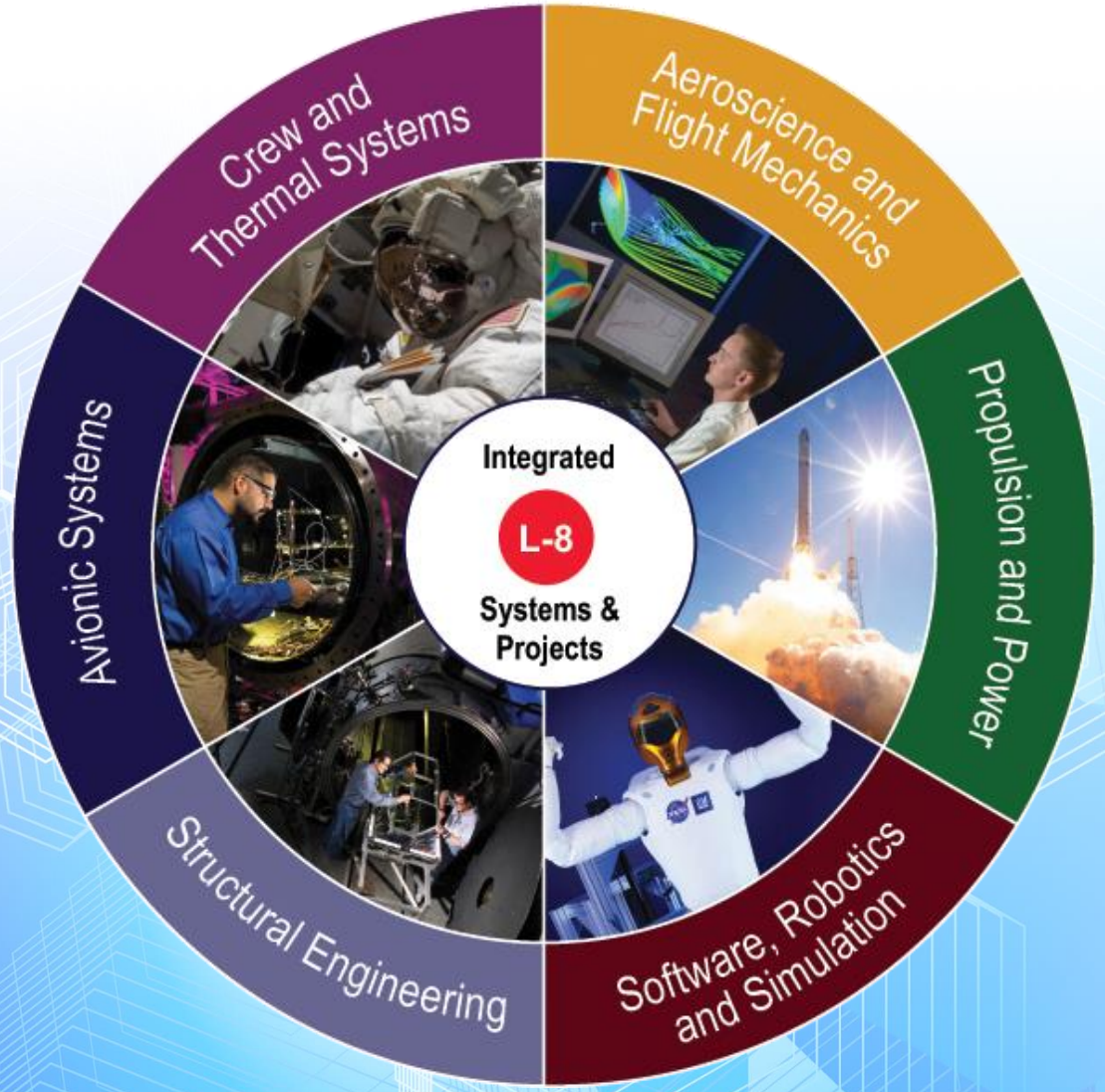
James Lewis

November 2016


JSC Engineering: HSF Exploration Systems Development



- We are sharpening our focus on Human Space Flight (HSF) Exploration Beyond Low Earth Orbit
- We want to ensure that HSF technologies are ready to take Humans to Mars in the 2030s.
  - Various Roadmaps define the needed technologies
  - We are attempting to define our activities and dependencies
- Our Goal: Get within 8 years of launching humans to Mars (L-8) by 2025
  - Develop and Mature the technologies and systems needed
  - Develop and Mature the personnel needed
- We need collaborators to make it happen, and we think they can benefit by working with us.

Boilerplate

EA Domain Implementation Plan Overview

JSC Engineering: HSF Exploration Systems Development

- Life Support
- Active Thermal Control
- EVA
- Habitation Systems

- Human System Interfaces
- Wireless & Communication Systems
- Command & Data Handling
- Radiation & EEE Parts

- Lightweight Habitable Spacecraft
- Entry, Descent, & Landing
- Autonomous Rendezvous & Docking
- Vehicle Environments

- Entry, Descent, & Landing
- Autonomous Rendezvous & Docking
- Deep Space GN&C

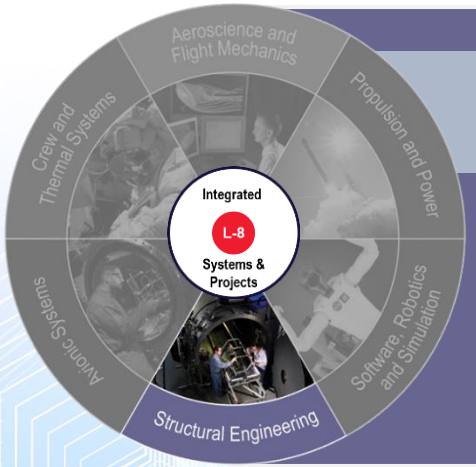
- Reliable Pyrotechnics
- Integrated Propulsion, Power, & ISRU
- Energy Storage & Distribution
- Breakthrough Power & Propulsion

- Crew Exercise
- Simulation
- Autonomy
- Software
- Robotics

AA-2 | iPAS | HESTIA | Morpheus

Boilerplate

Structural Engineering



- Autonomous Rendezvous & Docking
- Lightweight Habitable Spacecraft
- Entry, Descent, & Landing
- Vehicle Environments

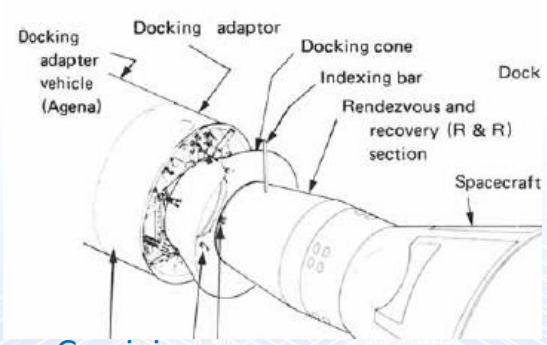
The Problem

- *JSC Engineering has responsibility for mechanical systems domain for advancing the current SOA to reduce mass, increase reliability, and increase performance for Human Space Exploration*
- *As humans and their systems leave low earth orbit (LEO) the reliability of mechanical systems has to increase as mass and volume decrease*
- *Flight proven systems are used at ISS today but were designed for LEO environments and a 90 min return to safety*

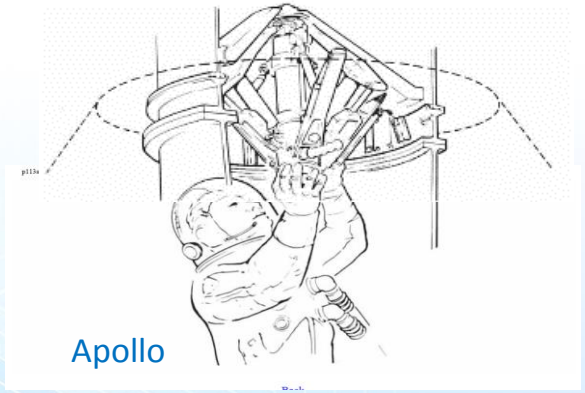
Docking Systems and other Attachment/Release mechanisms and related technologies

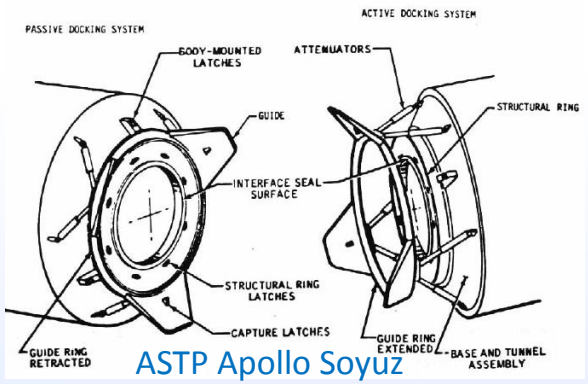
- *Extend and enhance the current SOA capabilities in the areas of overall performance, reliability, mass, controls, feedback, & safety*
  - *Game-changing infusion of ideas, innovation, and/or technology*
  - *Survey/review of analogous or similar attachment release mechanisms/systems used in other remote or hazardous applications; especially in areas where increased autonomy/automation is occurring*
- *Relatively few groups or organizations exist which develop or use existing space based technology.*
  - *Continued growth in the area of "commercial" use of and access to space provides new market potential.*
  - *Continued push for standardization of systems and components will enable supply chain competition.*
- *Co-develop dual-use technologies*
  - *Reliability – academia/research based or remote environments (subsea, mining, oil & gas)*
  - *Performance – automated control (robotics, automated manufacturing)*
  - *Electronics/SW/Sensing – miniaturization, ruggedization, simplification*
  - *Environmental – radiation, extreme temps, vacuum, dust*

Docking Systems

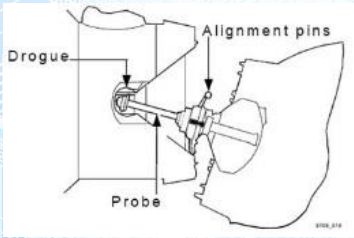


Gemini

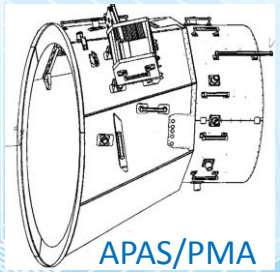

Apollo

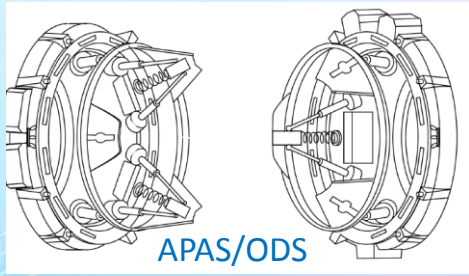


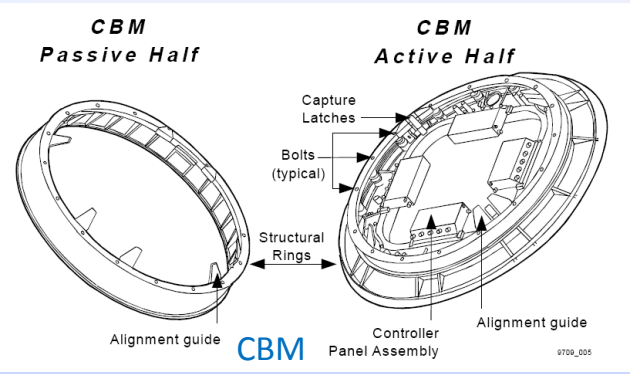
ASTP Apollo Soyuz



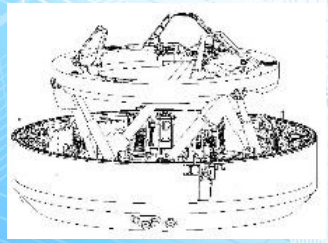
ISS/Probe-Drogue

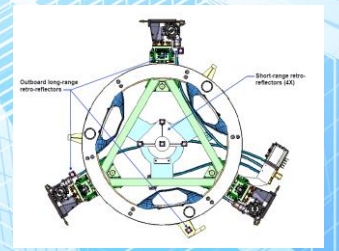

APAS/PMA

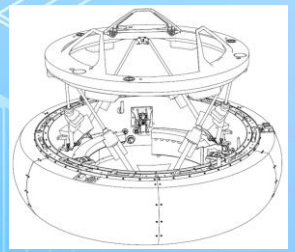

APAS/ODS

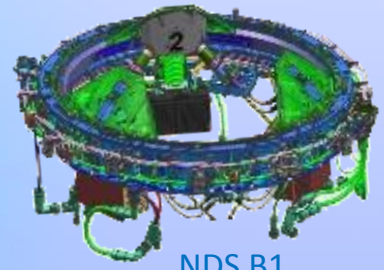


CBM


LIDS

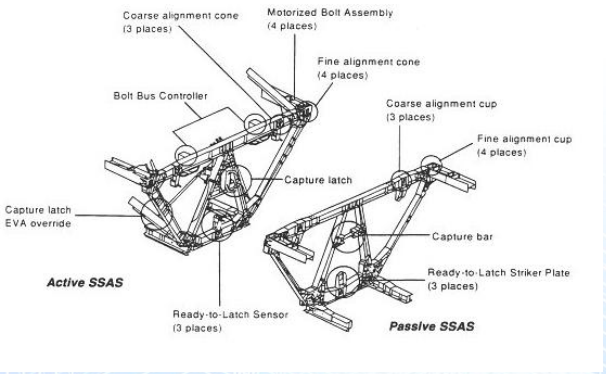

Hubble


iLIDS

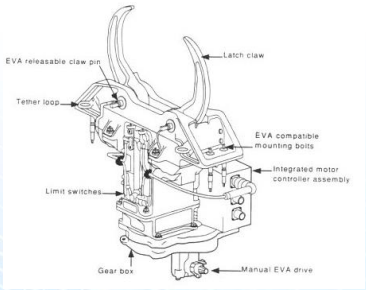

NDS B1

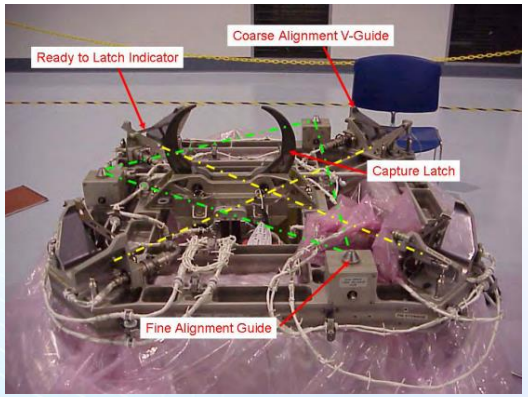

NDS-B2

Attachment Release Mechanisms



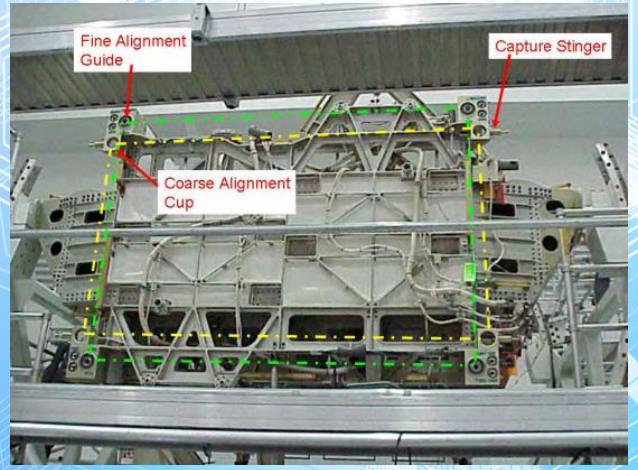
Segment to Segment Attachment System





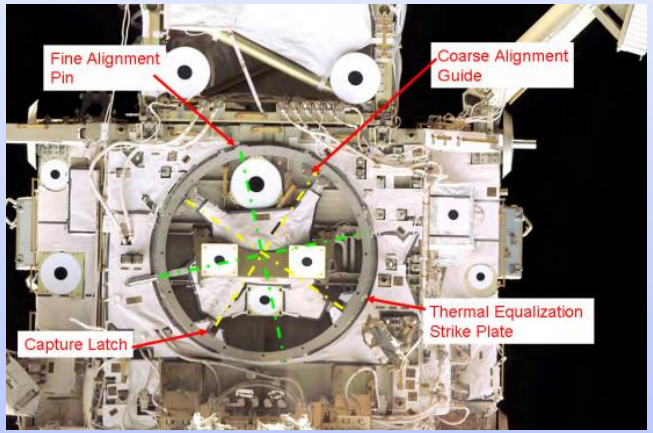
Module to Truss Segment Attachment System (MTSAS)

Carrier Attachment System



Modified Rocketdyne Truss Attachment System (MRTAS)

SSIKLOPS (Cyclops)
Space Station Integrated Kinetic Launcher for Orbital Payload Systems



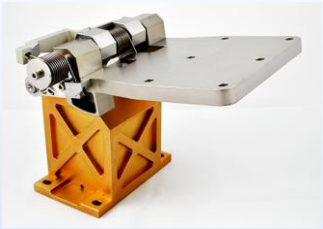
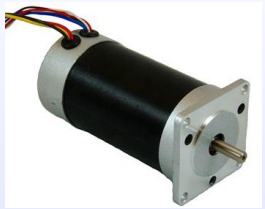
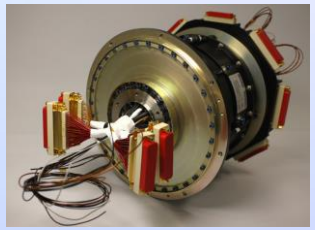
Exposed Facility Berthing Mechanism (EFBM)

Other Related Technology

- Rotary/Linear Actuators
- Customized Actuator Mechanisms
- Multi-Axis Gimbal Technology
- Antenna Pointing & Deployment Mechanisms
- Instrument Gimbals and Actuators
- Thruster Gimbals for Electronic Propulsion
- Solar Array Drive Assemblies
- Deployment and Damping Systems
- Stepper, Brushless DC and Bush Motors
- Open and Closed Loop Control Systems
- Pyrotechnic actuation
- Slip Rings






Capabilities/Expertise

- JSC Engineering's integrated environments and facilities test, evaluate, and certify components, materials, and hardware used in extreme environments.
- These capabilities:
  - Have application in manufacturing, energy production, and other industries requiring thermal vacuum chambers, high-heating environment and surface testing, electromagnetic testing, hypervelocity impact resistance, mechanical vibration, and acoustic vibration.
  - Are supported with unique analysis, modeling, testing & test results interpretation
  - Can be used to evaluate upgraded or redesigned components used in extreme environments to extend service life, enhance performance, and improve safety/reliability/fault tolerance.

Capabilities/Expertise

Design / Develop / Test

- Crew Survival Fact Sheet
- Electromagnetic Interference/ Electromagnetic Compatibility
- Entry, Descent, and Landing
- Extravehicular Activity Systems
- Extravehicular Mobility Unit
- Fabrication
- Flight Mechanics
- Guidance, Navigation, and Control
- Human-Rated Testing
- Launch Environment
- Environmental Control and Life Support Systems
- Materials Analysis
- Models, Simulation, and Software
- Power Systems
- Pyrotechnics
- Robotics
- Rendezvous, Proximity, and Docking
- Space Analog Environments
- Spacecraft Communications
- Structural Testing
- Thermal Testing
- Thermal Vacuum Testing
- Vacuum Test Facilities (Altitude Chambers)
- Launch Environment Vibration Testing
- Image Science and Analysis Laboratory

Operations & Training

- Neutral Buoyancy Laboratory
- Space Vehicle Mockup Facility

Human Health and Performance

- Biomedical Laboratories
- Environmental Monitoring, Analysis, and Data Assessment
- Extreme Environment Medical Capabilities
- Human Factors Engineering & Human Systems Integration
- Radiation Monitoring, Assessments, and Protection
- Space Food Systems

Safety and Risk Assessment

- Counterfeit Parts Detection
- Component and Material Validation
- Probalistic Risk Assessment (PRA)
- Safety Training
- Workmanship Training

Capabilities/Expertise

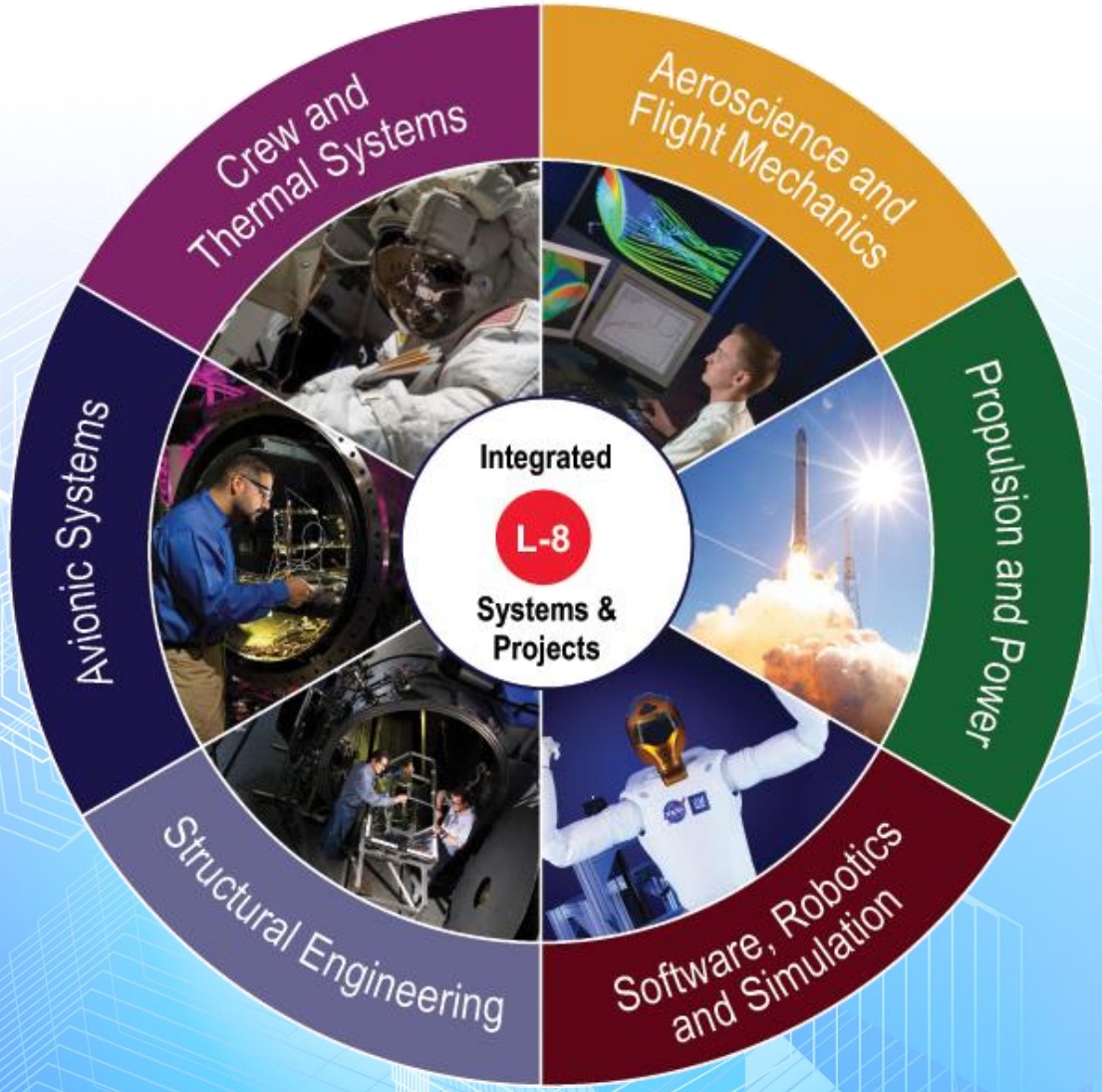
- CAE design and analysis
  - Integrated Electro-Mech Dev
  - Structures, Pressure Vessels
  - Composites, Inflatables
- Manufacturing and Assembly
  - Metallic non metallic
  - Additive Manufacturing Laboratory
  - QA Inspection
- Materials Evaluation Labs (MEL)
  - Scanning Elec. Microscopy (SEM) Lab
  - Analytical Chemistry Lab (ACL)
  - Metallography Polymer Labs
  - Nondestructive Evaluation (NDE) Lab
- Environmental Test
  - Static and Dynamic Test Facility (SDTF)
  - Modal Operation Lab (MOL)
  - General Vibration Lab (GVL)
  - Spacecraft Acoustic Lab (SAL)
  - Sonic Fatigue Lab (SFL)
  - Structural Test Lab (STL)
  - Spacecraft Vibration Lab (SVL)
  - Radiant Heat Test Facility (RHTF)

Let's Collaborate

We want your help!

- Looking for partners with relevant terrestrial systems and/or technologies
- Share experience and opportunities for demonstrating improved performance
  - Follow up discussion by email, by phone, F2F
  - Mutual site visits
  - Detail discussion of share areas of interest
  - Collaboration planning
  - Space Act or other agreements

JSC Engineering: HSF Exploration Systems Development

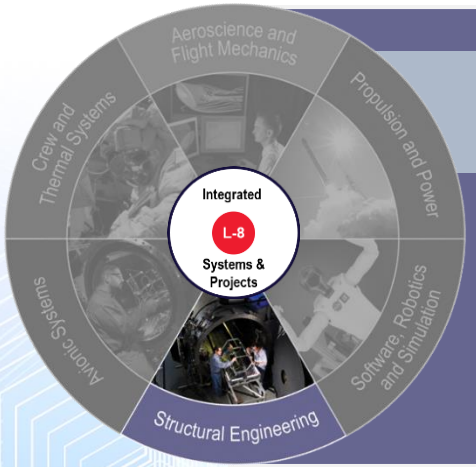


- We want to ensure that HSF technologies are ready to take Humans to Mars in the 2030s.
- Our Goal: Get within 8 years of launching humans to Mars (L-8) by 2025
- We need collaborators to make it happen, and we think they can benefit by working with us.
  - Pointer to Co-Dev Announcements
  - Pointer to intake site

Boilerplate

Temporary Backup

Structural Engineering



- Autonomous Rendezvous & Docking
- Lightweight Habitable Spacecraft
- Entry, Descent, & Landing
- Vehicle Environments

The Problem

- *Why do we (EA) want to do this?*
- *What problem are we solving?*
- *What is current SOA?*

Docking Systems and other Attachment/Release mechanisms and related technologies

- *The Effort being proposed*
- *The Idea we have*
- *Why someone might want to collaborate on this; commercial opportunities that might exist*
- *The kind of Collaboration we envision*
- *The kind of partner we expect*

Additional Content

- *Go heavy on pictures and Diagrams*
- *Bring hardware if you can*
- *Describe the opportunity*
- *Sell the partnership potential*